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**MINISTRY OF AVIATION**

**AIRCRAFT TORPEDO DEVELOPMENT UNIT**

**HELSTON**

**CORNWALL**

**PROGRESS REPORT**

**[U]**

NOVEMBER 1964

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FOR IT

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S E C R E T

Ministry of Aviation,  
Aircraft Torpedo Development Unit,  
Helston,  
Cornwall.

Progress Report No 2/64

TDU/61/06

Aircraft Torpedo Development Unit

Half-Yearly Progress Report

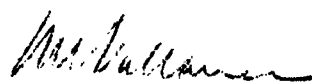
November 1964

This report concerns the work carried out during the period 1 May to 31 October 1964.

The number of torpedoes dropped is up on the same period last year due in the main to the environmental engineering programme. Initial results of these trials have been given to AUTE and will be used in the post design development phase of the Mk 44 torpedo. The level of work associated with development of flight in air equipment and aircraft CI Releases has remained fairly constant.

The Unit has been represented at the NATO Standardisation Meetings in Paris and Rome, and arrangements are in hand for active participation in the Armanent Winterisation trials on Wessex HAS Mk 5.

Now that the main development phase for flight in air material for Mk 44 torpedoes has been completed, it will be necessary to look forward and consider the problems associated with high speed release of current and future torpedoes which will be carried in the Shackleton replacement aircraft; whilst for the RN Admiralty Requirement NAST No 365 already stipulates a performance and world wide operational capability for a helicopter which makes the current flight in air equipment inadequate.

  
Superintendent

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- 7.1   Torpedoes
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PART 1 - AIRCRAFT INSTALLATION WORK IN PROGRESS

1.1 WESSEX HAS Mk 1

- (a) 2 x 18" Mk 30 - Extension of existing release clearance agreed with DGW(U).
- (b) 2 x UK Mk 44-0 - Modification kits to alter existing torpedo carrier to accept the Mk 44 torpedo are being supplied during October. Release clearance trials expected to start November 1964.
- (c) 1 x Clevite - A suitable system for carriage and air launch of the Clevite submarine simulator has been designed and proved in trials.

1.2 WASP HAS Mk 1

- (a) 2 x Mk NC 43-3 - Clearance trials completed.
- (b) 1 x UK Mk 44-0 - Clearance given.
- (c) 2 x UK Mk 44-0 - Awaiting arrival of aircraft fitted with modified engine and with airborne torpedo presetter.

1.3 GANNET AEW Mk 3

- (a) 2 x Mk NC 43-3 - Requirement cancelled.
- (b) 2 x Mk 44-0 - Clearance for release in level flight given; 30° dive trials to take place in November 1964.

1.4 SHACKLETON Mk 2 and Mk 3 (Phase 3)

- (a) 18" Mk 30 and (b) UK Mk 44-0

Mk 3 Phase 3 A & AEE trials aircraft commenced torpedo release trials at ATDU on 16 October 1964.

Mk 2 Phase 3 aircraft expected 1965.

NOTE - Full details of progress made in respect of these installations are given in Part II or Part III under the appropriate project headings.



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PART II - TORPEDO AND MINE PROJECTS

2.1 18" Mk 30 torpedo

(a) Release from helicopter aircraft

(1) Wessex HAS Mk 1

The Mk 30 torpedo fitted with parachute attachment type AT/J is cleared for release from Wessex HAS Mk 1 at heights and speeds above 50 ft and 30 kts respectively.

It has been demonstrated in trials that both exercise and action Mk 30 torpedoes released below these heights and speeds may not reach torpedo start depth in the initial dive. Whereas the standard buoyant exercise torpedo under these conditions will of course never start, the action weight torpedo eventually sinks to start depth. Under these conditions an action torpedo may take between 28 to 50 seconds to reach running depth.

The position has been discussed with DGW(U) and it has been agreed that since the delay with the action torpedo occurs only following release at very low speed and heights this is acceptable and an extension of the release clearance can be given.

Action torpedo

Clearance for release over the full speed range Hover to maximum speed at heights of 30 ft and above.

Exercise torpedo

Subject to the incorporation of modifications to the torpedo start arrangement, as per Amendment Nos 1 to 14 to BR 1545, extension of the existing clearance as follows:-

Clearance for release, without parachute attachment fitted, at speeds up to 25 knots and heights up to 35 ft.

(b) Release from fixed wing aircraft

Shackleton Mk 3 Phase 3

18" Mk 30 torpedoes, fitted with the AT/C Mod 1 parachute attachment, will be released from the Shackleton Mk 3 Phase 3 aircraft during the clearance trials commenced this month.

2.2 Mk NC 43-3 torpedo

(a) Release from fixed wing aircraft

(1) Gannet AEW Mk 3

The requirement has been cancelled though some work has been done.

(b) Release from helicopter aircraft

(1) Wasp HAS Mk 1

Release and jettison clearance of 2 x Mk 43 torpedoes, fitted with parachute attachment type AT/K, completed. Service clearance issued. Full report on trials in preparation.

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2.3 UK Mk 44-0 torpedo

UK Mk 44-0 torpedo acceptance trials

Trials conducted by TTU to prove warhead detonation were completed off Malta during September. All torpedo drops were made from Shackleton aircraft, torpedo flight in air material behaviour being satisfactory.

(a) Release from fixed wing aircraft

(1) Gannet AEW Mk 3

Trials to clear the Gannet for release and jettison of UK Mk 44-0 torpedoes from the wing pylon installation at speeds up to 180 knots have been completed. All torpedoes dropped were fitted with parachute type AT/L and breakaway band Type "C".

During the course of the clearance trials catapult and deck arresting trials of the aircraft with 2 x Mk 44 torpedoes carried took place at RAE Bedford. To complete these trials following a catapulted take off from RAE Bedford, the aircraft made a 1 hour 45 minute flight to the Falmouth bay range to drop two runner torpedoes.

The torpedo presetter was used in the air prior to release and for both drops behaviour of the 'flight in air' equipment and the subsequent underwater behaviour of the torpedoes was satisfactory.

A report has been written detailing these trials and recommending torpedo release clearance over the speed range 130-180 kts at heights of 500 ft and above.

Further trials to clear the aircraft for torpedo release in 30° dives and at speeds up to the aircraft maximum speed are planned to take place at the end of the year. As previously reported it was noted that the torpedoes oscillated violently (up to 70° from trajectory) at the higher release speeds.

(ii) Shackleton Mk 3 Phase 3

A & AEE aircraft arrived at ATDU to commence torpedo release clearance trials on 16 October. Some difficulties in connection with the strong points required on the aircraft to suit torpedo flight in air material have been encountered.

Flights in addition to those originally planned to cover the torpedo release programmes have been requested by A & AEE, primarily to obtain further data on the behaviour of the carrier release slips.

(b) Release from helicopter aircraft

(1) Wessex HAS Mk 1

Modification sets to convert the Mk 30/43 torpedo carrier to carry Mk 44 torpedoes and to cover the installation of the airborne torpedo presetter are expected to be supplied this month.

It has been agreed that a Culdrose squadron aircraft will be fitted with the modification sets and used for the clearance trials. Trials are expected to take place during November/December.

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(ii) Wasp H/S Mk 1

Clearance for release 1 x Mk 44 issued. Clearance for release of 2 x Mk 44's awaits arrival of aircraft fitted with modified engine and airborne presetter.

(c) General Development Trials with UK Mk 44 torpedo

(i) Helicopter aircraft

AT/K parachute attachment is now in production for Service Use to deliver both Mk 43 and Mk 44 torpedoes from all UK helicopter aircraft.

(ii) Fixed wing aircraft

During the Shackleton clearance trial (see above) it has been agreed with the Torpedo Trials Unit of AEWB that all runner torpedoes dropped will have neutral control settings in order to investigate the effect on the initial dive of the torpedo, and to eliminate any tendency to breaching which occurred occasionally during the Malta acceptance trials.

2.4 Breakaway suspension band type "C"

The breakaway suspension band Type "C" for use with the Mk 44 torpedo when carried on Wasp, Wessex and Shackleton aircraft, is now in production for Service Use.

The Gannet trials (see section 2.3a) have proved the band satisfactory for Gannet use and official acceptance is expected before the end of the year.

2.5 UK Mk 44-0 torpedo airborne presetter

During the Shackleton Mk 3 Phase 3 trials the airborne presetter will be checked out, as previously covered in Wasp and Gannet trials.

During the Gannet trials the torpedo setting indication lights were criticised as being inadequate and similar comments were made in the Wasp trials. It is hoped that modification action will shortly be taken.

Information regarding the airborne presetter performance has been forwarded to Australia House at the request of MOD Navy.

2.6 Parachute Attachment Type AT/L

Drawings of the AT/L attachment have now been sealed under MRI No AT 52 and initial production has started.

A possible modification to the parachute release mechanism is being investigated which may simplify production and reduce costs. A prototype has been designed and three units are being manufactured for trials.

2.7 Mine Mk 14

No further work on this item.

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2.8 Delivery system for high speed aircraft launching of anti-submarine

(i) Mk 44 torpedo

In view of the expected life of the UK Mk 44 torpedo in service use, a design study has been made of a delivery system to launch the torpedo from aircraft capable of 400 knots eg Shackleton replacement.

The study indicates that a two stage parachute delivery system is a practical proposition which would solve the problems of avoiding any excessive parachute opening shock load on the torpedo tail shaft while giving the torpedo an acceptable water entry speed.

The two stage design proposed has the added advantage that by suitable choice of a second stage parachute it could provide a means of cutting down the depth of dive of the proposed 'shallow water' version of the weapon.

It is proposed that approval be given to the production of test items to enable this investigation to continue.

(ii) Mk 46 torpedo

The two stage parachute system proposed above has been designed to be equally suitable for air launching this torpedo at high speed, ie possible IKARA system.

2.9 Parachute attachment development

During development trials of new delivery systems it has become increasingly important to measure parachute opening loads accurately.

An 'Impactograph' has been obtained and will be used to measure parachute loads in all future development work and trials are now taking place to establish its capabilities and response characteristics.

2.10 Clevite

Development and trials of a system to air launch the Clevite submarine simulator from the Wessex HAS Mk 1 have been completed.

Westland Aircraft Co are being supplied with drawings showing the modifications required to the torpedo carrier boom. Drawings are also being finalized to cover production of the suspension band designed to provide a means of carriage of the simulator.

2.11 NATO Meeting on Mk 44 torpedo interchangeability

ATDU have been participating in a NATO study to determine the maximum practicable interchangeability of the Mk 44 torpedo and its components. It is hoped to define those torpedo items which are interchangeable, including torpedo flight in air material, at the next group meeting in December.

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PART III - MISCELLANEOUS PROJECTS

3.1 Helicopter recovery

The report of trials with the helicopter recovery device has been received from the Flag Officer, Naval Command Devonport. Pending some minor modifications the equipment has been recommended for use as the "Initial Outfit for Helicopter Recovery Device".

The Drawing Office are awaiting details of above modifications for incorporation in master drawings.

3.2 Anti-submarine ~~trial~~ trials

There have been no further trials during the period. Attempts to recover the vehicle that was lost on the range has been abandoned.

Further trials by Hunting Eng Ltd at ATDU are due in the first quarter of 1965.

3.3 Special Tool for Type 'C' band

A special tool for attaching the Type C breakaway band to the Mk 44 torpedo has been developed from an idea which originated in the R/F Section, ATDU. A set of tools comprising a hook and safety plate have been manufactured and a set of drawings produced under Drg No AT 24382 MRI AT 60.

A suggestion award claim is being made by the R/F personnel concerned.

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PART IV - INSTRUMENTATION AND ANALYSIS IN SUPPORT OF TRIALS

4.1 Recording of peak shock loads

(a) The electronic shock register was installed in a dummy Mk 44 torpedo and used by the Environmental Eng Section, twenty drops were made in all. The instrument itself remained serviceable, but four drops were abortive; one because of a transducer breaking up and three because of arming switch failures. The latter failures all occurred during the early stages of the trial and the difficulties have been overcome.

Additional circuits were produced to enable shock durations to be measured. The instrument was brought back into use during September and trials are continuing.

The possibility of producing a small number of general purpose electronic shock monitors is being considered. The design of these would be based on the existing prototype but would incorporate differences to make them more easily installed and used. Work on these instruments would not start until the new year, after the tape recording installation has been completed.

(b) Analysis work on mechanical shock recorders has been confined to the 'Impactograph' and reed gauges.

The 'Impactograph', an American scratch recorder was used in conjunction with the electronic register and the results demonstrated that the 'Impactograph' high frequency response limits the use of the instrument for measuring directly the water entry shocks. Trials to measure parachute opening shocks will start with a more sensitive stylus assembly in a motorised version.

Some reed gauge results have been obtained, again in conjunction with the electronic register. Resonant frequencies of the reeds have been generally too low for the very short initial shock peak to be measured. Whether reed gauges will ever prove a practical proposition for recording water entry shocks is open to doubt because of the very short scratch length that would be obtained from a reed having a sufficiently high resonant frequency.

4.2 High-speed recording

Work on the final items for this equipment is now in hand. The recording system will be required in its finished state for the Drop Test Machine.

4.3 Accelerometer calibration rig (vibrating beam)

Design of the control system is completed and work is now in hand to finish the instrument.

4.4 Drop Test Machine

The main structure of the drop test machine is now completed, and the six ton concrete base on which the machine is being erected has been laid. A cathode follower is being produced by Instrumentation Section for use with the piezo-electric transducer which will be mounted on the falling table. The Design Section have been asked to look into the problems associated with producing a hydraulic programmer, in preparation for the time when more effort may be given to this project.

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4.5 Centrifugal calibrator

An order was placed in September for a motor and speed control unit for the centrifugal calibrator. Now that the drive system has been selected the Design Section will be able to proceed with the layout of the turntable and control panel in a mobile console. Instrumentation Section are investigating the problem of the noise level at the pick-ups to ensure that the a.c. signal to the inductance bridge accelerometers is not adversely affected. Smaller diameter slip rings may be required.

4.6 Torpedo recorders

There is nothing further to report.

4.7 MTDU tape recording equipment

Design work is completed on most of the items that are to be produced by MTDU. Work is in hand to manufacture the ancilliary equipment and to install the whole assembly of electronic equipment on bulkheads to fit the standard Mk 44 electronic frame.

4.8 Instrumentation on the outer ranges

The system of using a second helicopter to take vertical pictures of the range during a drop has been used satisfactorily. The operational limitation is that a cloud base above 2000 ft is essential. The alternative solution to the problem of analysis of results obtained on the outer ranges namely the use of Type 303 marine radar has been thoroughly investigated and it is considered will provide the complete answer; contract action has been taken to cover the supply and fitment of the equipment to both pinnaces.

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PART V - WORK CARRIED OUT FOR OTHER DEPARTMENTS

5.1 Pyrotechnics

Two proofing trials of production lots of Smoke and Flame Floats, No 1 Mark 3 have been carried out on behalf of DI Arm Woolwich, employing the ASWDU Shackleton aircraft. In each test 48 stores were dropped. Personnel of the RIF element at ATDU assisted the DI Arm observers in the collection of performance data. A further consignment of 48 stores has recently arrived. These will be dropped from the A & AEE Mark 3 Phase 3 Shackleton presently engaged on Torpedo clearance trials. 20 Markers Marine with modified parachutes are shortly to arrive from R/RDE. These too, will be released from the A & AEE Shackleton. R/RDE are also sending a quantity of modified Smoke and Flame floats to be dropped from a Gannet aircraft of RNAS Culdrose. The improved ASTI is expected in the New Year for release trials.

5.2 Wasp Transponder Aerial

Two frangible aerals have been manufactured by ATDU and a decision is awaited from the RN as to whether or not trials will be required. It is understood that another possible location for the transponder aerial is being investigated.

5.3 RN Blast Trials - Wasp Helicopter

Trials have begun at HMS "Excellent", Portsmouth to test the effects of Gun Blast on the Wasp Helicopter and its operational load of 2 x Mk 44 torpedoes. ATDU were asked to loan flight in air material for the trials and were invited to send an observer. The Trials, which have been postponed for inspection of the Wasp, are expected to recommence at the end of November. It is intended to loan two time expired runner Mk 44 torpedoes for this next phase.



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PART VI - ENVIRONMENTAL TESTING OF TORPEDO AND FLIGHT  
IN AIR MATERIAL

6.1 Vibration measurements using Midas tape recording instrumentation

(a) Shackleton MR Mk 2 Phase 2 - clearance for the carriage  
of Mk 44 torpedoes

The graphs showing acceleration level against frequency, which were produced by R/E from the tape recordings, were summarised by A & AEE mathematical section. Their results have been tabulated and examined for general tendencies. A letter report will be issued shortly by ATDU on the conclusions to be drawn from these trials.

(b) Shackleton MR Mk 3 Phase 3 - clearance for the carriage  
of Mk 30 and Mk 44 torpedoes

The instrumented torpedoes prepared by ATDU were used in the recently completed carriage trials at Boscombe Down. Early indications are that the vibrations were no more severe than on the earlier Shackleton investigations, and the temperature elements showed that no hot spots were present on the torpedoes skin.

(c) Wessex HAS Mk I investigation into vibrations in Mk 30  
and Mk 44 torpedoes

Selected passages from the tape recordings obtained during the flight trials held earlier this year were analysed by R/E Weapons Department. The graphs showing acceleration against frequency are now being summarised at ATDU for inclusion in the report which will be issued shortly.

(d) Gannet LEW 3 - investigation into vibrations in Mk 44  
torpedoes

It is planned to carry out a number of sorties to investigate the vibration environment in a Mk 44 torpedo when carried by a Gannet LEW 3. It has been agreed with the DPO that the aircraft which is returning to ATDU for completion of the release clearance trials may be used for this work. In the event of this trial not being completed before the departure of the Gannet Squadron from RNAS Culdrose, a case has been made to use the aircraft operating from A & AEE.

(c) Wasp HAS Mk I - investigations into vibration in  
Mk 44 torpedoes

The mounting cradle for carrying the Midas airborne recording equipment has been modified for use in a Wasp helicopter and flight trials are progressing.

6.2 Shock measurements using ATDU tape recording equipment

(a) Mk 44 ex-runner torpedo

A tail unit has been modified to accept the line recovery gear, which has been manufactured by the workshops, and trials will now commence to test this system of recovery. Much of the manufacturing work entailed is the water jettison system which is now completed and proving trials will run consecutively with the above programme.

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A tape recorder mounting employing expanded polystyrene has been designed and manufactured: its effectiveness in isolating the tape transit mechanism from simulated water entry shocks will be investigated on the drop test machine.

Design of the electronic panels is well advanced only one being outstanding together with the general arrangements of the completed instrumentation.

6.3 Shock measurements using mechanical or other electronic instruments

(a) Mk 44 dummy torpedoes

Of the two dummy torpedoes which were modified to carry a variety of instruments, one design proved superior to the other in ease of dismantling. As some of the instruments necessitate the torpedo being opened after every drop the majority of the trials are carried out using this one store.

(b) Reed gauges

The results from several drops in which the five bank reed gauge was installed are now being studied. The natural frequencies of the reeds used ranged from 40 to 120 c.p.s. There was some evidence to suggest that the half pulse duration varied from 4 - 8 millisecon, but the peak acceleration values did not correspond with those obtained from the peak "g" box. This was presumably due to the half pulse duration of the signal being less than the reeds time constant. Reeds with much higher natural frequencies will be tried in an attempt to obtain records of peak acceleration values, but difficulties in analysing may be encountered as the scribed arc per "g" becomes smaller when the natural frequency rises.

(c) Inertia switches

A number of drops have been carried out with both the single setting and micrometer adjustable inertia switches mounted in the store. At small water entry angles, when the pulse duration is at a maximum, they respond satisfactorily, but as the angle of entry increases and pulse duration decreases they become progressively more inaccurate. The frequency response of these instruments is not low enough to enable them to record the water entry shock.

(d) Impactograph

The results obtained from the impactograph follow the same pattern as described above for the inertia switches: they record peak "g" level satisfactorily up to water entry angles of 60°, but beyond this point their frequency response is not suitable for recording the short duration water entry pulses. This instrument may give satisfactory results with the longer duration parachute opening loads.

(e) Peak "g" recorder

This instrument has been in use for a considerable number of drops in its basic form and the results show that the peak retardations measured along the longitudinal axis of the torpedo ranged from 20 g to over 100g as the water entry angle increased from 30° to 90°. A modified version incorporating a timing device to measure the duration of two selected "g" levels has been produced by instrumentation section. This confirms the results from the Reed Gauge and other instruments that the pulse becomes of shorter duration as the water entry angle increases. A typical result obtained with a water entry angle of 60° showed the peak "g" reading to lie between 19 and 26g, and the duration at the 15 and 7g levels to be 0.5 and 6.5 millisecon respectively: this indication that the pulse is spikey is borne out

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by all the drops so far carried out, but further drops are required before a more general pattern can be established.

6.4 Low temperature tests on torpedoes and flight in air material

(a) Wessex HAS Mk 5 Winterisation trial

ATDU were invited to participate in the above trial which is to be conducted by A & AEE in Canada during the winter of 1964-65. Three torpedoes have been prepared. One Mk 43 and one Mk 44 were ballasted to action weight but were externally similar to runner torpedoes: these will be used for handling trials prior to being released. The third store, a Mk 44 ex-runner, has been fitted with temperature elements for measuring the temperature at various positions within the torpedo both on the ground and during flight.

(b) Type C breakaway band

Functional tests on breakaway bands and lifting tests on bungees will be carried out as part of the winterisation trials. The general arrangement drawings have been amended to call up externally applied anti-freeze grease on the timer unit to minimize any icing tendencies.

(c) AT/K parachute release mechanisms

As a result of the chilling tests carried out on type B release mechanisms a protective cover was designed to minimize the ingress of moisture and thus reduce the effects of icing up. Trials were conducted at ATDU to prove that the fitting of these rubber covers had no deleterious effects on the functioning of these mechanisms. It is proposed to carry out both ground and flight tests to assess the efficacy of these covers under arctic conditions during the winterisation trials.

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PART VII - SUMMARY OF DROPS FOR PERIOD 1 MAY to 31 OCTOBER

7.1 <u>Torpedoes</u>		<u>NO. OF STORES</u>
<u>TRIAL ORDER</u>	<u>OBJECT OF TRIAL</u>	<u>DROPPED</u>
T/63/C	Wasp H.L.S Mk 1 Limited Cl. Release	
	Release and jettison of torpedoes (Mk 44-0), DMW buoys and pyrotechnic stores	4
T/63/E	Camera Coverage	10
T/64/I.	Carriage, Release and Jettison trials of UK Mk 44 and NC Mk 43-3 torpedoes from Gannet LEW Mk 3 aircraft	10
T/64/C	Wasp H.L.S Mk 1 2 x Mk 43 MOD 3 release clearance	36
T/64/D	Release flights to clear Shackleton Mk 3, Phase 3 aircraft in Mk 30 and Mk 44 torpedo role	35
T/64/E	Carriage and Release flights to clear Wessex H.L.S Mk 1 to air launch Cleovite submarine simulator	9
T/64/F	Trials of US Mk 14 MOD 3 parachute release mechanism	3
E/64/C	Initial Investigations into parachute opening and water entry shocks	47
	TOTAL	154
7.2 <u>Other trials</u>		
E/64/D	Carriage flight trials "MIDAS" vibration investigation (1 sortie 3 hour flying)	0
FP/64/I.	To prove lots of various air pyrotechnics	96
	GRAND TOTAL	250

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SP4 0JQ  
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Fax 01980-613970

Defense Technical Information Center (DTIC)  
8725 John J. Kingman Road, Suit 0944  
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